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NOTES ON GEOGRAPHIC DISTRIBUTON

New record of *Furipterus horrens* (Cuvier, 1828) (Chiroptera, Furipteridae) in eastern Brazilian Amazonia

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Abstract. The bat *Furipterus horrens* (Cuvier, 1828) is endemic to the Neotropics, and in Brazil, it is widespread. However, there are few records in the Amazon Region where it is known only from the states of Amazonas and Pará. Here, we report the occurrence of a colony of *F. horrens* in an anthropogenic environment in the Brazilian Amazon. This type of habitat has not been previously reported for this species. We also compile and update the known occurrences of *F. horrens* in Brazil. Our new data brings to the number of localities for this species in Brazil to 76.

Key words. Bat new record, updated inventory, threatened species, Vulnerable

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INTRODUCTION

The bat family Furipteridae has two monotypic genera, *Amorphochilus* Peters, 1877 and *Furipterus* Bonaparte, 1837, which are endemic to the New World tropics (Husson 1962; Walker 1975). The occurrence of *Furipterus* extends across Costa Rica to southern Brazil and includes Colombia, Venezuela, Guyana, Suriname, French Guiana, Peru, Bolivia, and Trinidad and Tobago (Koopman 1993; Gardner 2008; Peracchi et al. 2011; Bredt et al. 2018). *Amorphochilus* has a much more restricted distribution and occurs in a narrow band west of the Andes mountains that runs from Peru to northern Chile (Ibanez 1985; Falcão et al. 2015). Only *Furipterus*, represented by *Furipterus horrens* (Cuvier, 1828), Thumbless Bat, has been recorded from Brazil (Husson 1962; Piccinini 1974; Uieda et al. 1980; Nowak and Paradiso 1984; Gardner 2008).

Furipterus horrens is one of the smallest bats found in the Neotropical Region (Uieda et al. 1980; Nowak 1994). This slow-flying, strictly insectivorous bat has a delicate appearance, with long, dense greyish fur, a body length of 3.0–4.0 cm, weight of 2.4–3.0 g, and forearm length of 34.3–35.3 mm (Uieda et al. 1980; Nowak 1994; Bredt et al. 1996; Simmons and Voss. 1998; Peracchi et al. 2011). *Furipterus horrens* has two unique morphological traits: 1) a very reduced thumb (hence the common name, Thumbless Bat) due to the significant reduction in the length of this digit, which is covered by the alar membrane up to the base of the nail, and 2) the presence of a pair of nipples on the abdomen, just above the genitalia (Uieda et al. 1980; Nowak 1994; Leal et al. 2014).

Behavioural observations of *F. horrens* have shown that this bat forms colonies that vary considerably in size, ranging from small groups of 3–6 individuals (Mares et al. 1981; Trajano 1985; Novaes et al. 2012) to major agglomerations of 20–300 bats (Uieda et al. 1980; Nowak 1994; Bredt et al. 1998, 2018). La Val (1977) found a colony composed only of male individuals, implying the possibility of sexual segregation, with males of this species sheltering separately during specific times of the year (Uieda et al. 1980). It is also possible that, as observed in other cave-dwelling bats, that the size of the colony directly corresponds to the size of the roost (Uieda et al. 1980; Luo et al. 2013).

Furipterus horrens seems to be regularly associated with karst formations, roosting mainly in caves and caverns (Uieda et al. 1980; Simmons and Voss 1998; Guimarães et al. 2014; Bredt et al. 2018), although it has already been found roosting in tree holes and under fallen trunks (Simmons and Voss 1998). Guimarães et al. (2014) defined *F. horrens* as principally cave-dwelling and recommended using it as an indicator of

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the presence of caves, although these authors also define this species as a trogloxene, a cave-dwelling organism dependent on the external environment to complete its life cycle.

In recent years, however, the protection of Brazilian cave environments has been relaxed. The publication of Federal Decree 6.640/2008 raised the possibility that some natural subterranean cavities would not receive adequate protection unless the site was of extreme environmental relevance, that is, within an area that merits strict protection. In this specific case, however, it would be necessary to prove that the site is essential to the preservation of threatened species (Brasil 2008).

The inadequate protection of caves represents a major threat to *F. horrens*, given that many cave environments are threatened by human activities, including mining (Guimarães et al. 2014; Portella et al. 2017; Bredt et al. 2018) and flooding by hydroelectric projects (Aguiar et al. 2009; Bernard et al. 2012). Other potential threats include the recreational caving, deforestation, and inadequate forest management (Hutson et al. 2001; Bernard et al. 2012; Bredt et al. 2018).

There are no records of *F. horrens* from urban areas or anthropogenic environments (Bredt et al. 2018). Bredt et al. attributed this absence to the sensitivity of *F. horrens* to negative environmental changes and this species' incapacity to adapt to anthropogenic landscapes. Given these considerations, *F. horrens* is classified as Vulnerable in Brazil based on the criteria applied by the Brazilian Environment Ministry, through ordinance MMA-148 of 7 June 2022 (Brasil 2022). The criteria used in assessing this species are habitat loss and estimated population decline of at least 30% over the next 10 years (ICMBio 2018).

Furipterus horrens is widespread in Brazil, except in the Pampas and Pantanal biomes. There are records from the Federal District (Bredt et al. 1999) and the states of Amazonas (Piccinini 1974), Pará (Piccinini 1974; Tavares et al. 2012), Tocantins (Sato et al. 2011; Novaes et al. 2012), Piauí (Araújo et al. 1998; Gregorin et al. 2008), Ceará (Piccinini 1973; Uieda et al. 1980), Rio Grande do Norte (Vargas-Mena et al. 2018), Paraíba (Leal et al. 2014), Pernambuco (Mares et al. 1981), Sergipe (Astúa et al. 2008), Bahia (Faria et al. 2006), Goiás (Coimbra et al. 1982; Esbérard et al. 2005), Minas Gerais (Tavares et al. 2010), São Paulo (Trajano et al. 1985), Espírito Santo (Duda et al. 2012), Rio de Janeiro (Pol et al. 2003), Paraná (Portella et al. 2017), and Santa Catarina (Lima 1926; Cherem et al. 2004). Only two of these states, Amazonas and Pará, are in the Brazilian Amazon Region. The most recent records from Pará are from the Fazenda Taperinha, in the Municipality of Santarém (Piccinini 1974), the Serra do Cachimbo in the Municipality of Altamira (Duda et al. 2012), the Municipality of Anapú on the middle lower Xingú River (Ferreira et al. 2008), the Belo Monte Hydroelectric Dam on the lower Xingú (Aguiar et al. 2009), and the Carajás National Forest (Tavares et al. 2012).

New occurrence records of *F. horrens* in Brazil and further data on the behaviour and ecology of this bat will be important for effective conservation and management strategies of this species in its natural environment. In this context, we document a new record of *F. horrens* in eastern Brazilian Amazonia, the first time this species has been found in an anthropogenic environment. We also compile and update the known geographic distribution of *F. horrens* in Brazil based on our review of published occurrence records.

METHODS

The data collected were obtained from the observation of a group of *Furipterus horrens* known since 2015 on a private property called Fazenda Paloma, in the municipality of Novo Repartimento, in the state of Pará, Brazil (Figure 1). The region's climate is tropical humid megathermic (Am) according to the Köppen classification; it has an average air temperature of 26 °C, an average annual rainfall of 2000 mm, with a moderate dry season between June and October (with an average rainfall of 50 mm), and a rainy season between November and May (with an average rainfall of over 300 mm) (Hoffmann et al. 2018; Gonçalves et al. 2019).

Our study was based on 32 days of data collection, with 768 h of direct monitoring of the *F. horrens* colony in June, August, and October to December 2021 and January 2022. We made counts of the number of individuals present in the roost, based on photographic records and video monitoring of the colony. It was not possible to capture and manipulate the individuals, because it was during the COVID-19 pandemic and the team's vaccination schedule for the COVID-19 virus was not complete. Data collection was authorised by ICMBIO/SISBIO under licence 80253-1.

The photographic records were taken between June 2021 and January 2022 using a Sony DSLR-A230 single lens reflex digital camera. This sampling was conducted on alternating days and months between 10:00 h and 11:00 h, prior to the installation of the filming equipment, to minimise stress and the potential for the colony to disperse. The photograph with the largest number of perfectly visible bats was selected from each sample for the group counts.

The colony was video-monitored continuously over periods of 2 d (48 h), between 12:00 h on the day of the installation of the cameras to 12:00 h of the second subsequent day, with six monitoring sessions in October, November, and December 2021. The video footage was obtained using two high-resolution Intelbras HDCVI Lite 1-megapixel VHL 1120B 20 M video cameras with 3.6 mm lenses and infrared night vision. These cameras were installed 40 cm above the ground and connected to an Intelbras 1108 MHDX MDCVI multi-HD NVR 8-channel DVR recorder. This equipment was powered by a rechargeable 105 A battery.

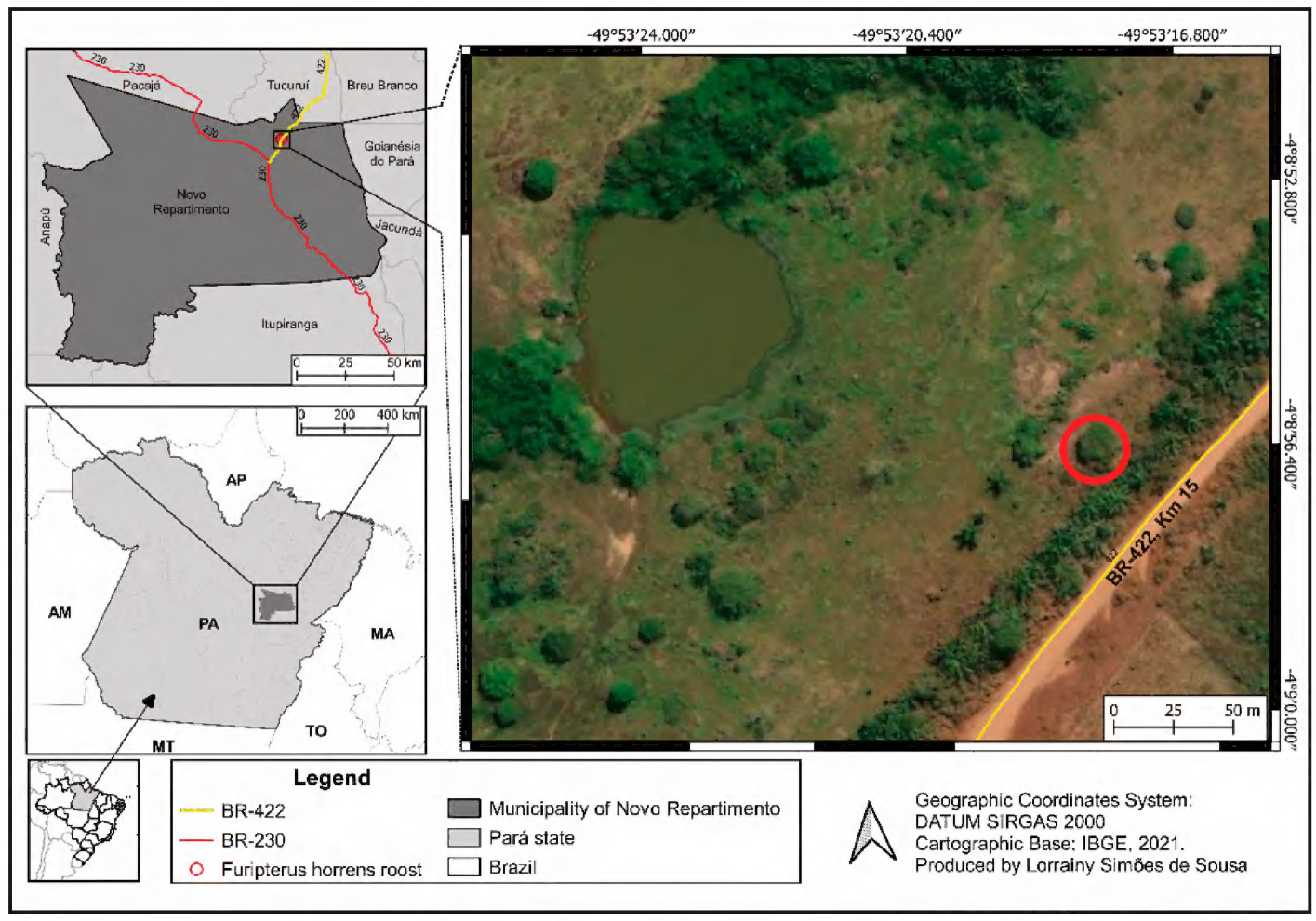

Figure 1. Location of the Fazenda Paloma in the Municipality of Novo Repartimento, Pará, Brazil, showing the *Furipterus horrens* roost (red circle). Satellite image source: Google Earth 2022.

RESULTS

The species was photographed of several individuals under a rocky outcrop surrounded by extensive areas of pasture in Fazenda Paloma, a privately owned cattle ranch located at km 15 of the federal highway BR 422 (Figures 1, 2A).

The rocky outcrop used as shelter by *F. horrens* is approximately 30 m in circumference and 6 m high, partially surrounded by shrubby vegetation (secondary forest), and 20 m from the edge of the BR 422 highway. Internally, this rock formation has a sloping roof and sandy-clay soil, with openings at the front (2 m high) and sides (0.8–1.5 m high at the back). The side openings are smaller and make it difficult for an adult human to enter (Figure 2B, C). There are other smaller rocky outcrops in the vicinity, but no bats were observed in these. The landscape is generally composed of fragments of degraded Ombrophilous Dense Forest with extensive pasture matrix as a result of cattle ranching.

Order Chiroptera
Family Furipteridae
Genus *Furipterus* Bonaparte, 1837

***Furipterus horrens* (Cuvier, 1828)**
Figure 3A

New record. BRAZIL – **Pará** • Municipality of Novo Repartimento; 04°08'56"S, 049°53'18"W; 200 m alt.; 14.VI.2021 to 26.I.2022; Monteiro, Andrade, Simões & Lima obs.; under a rocky outcrop surrounded by extensive areas of pasture.

In 16 samples counting the number of *F. horrens* present in the roost between June 2021 and January 2022, The number of roosting individuals averaged 94 (16 counts taken during the duration of our study). The fewest individuals (n = 67) was in August 2021 (dry season), while most individuals (n = 132) was in January 2022 (rainy season).

On the same rocky outcrop we occasionally recorded other bat species: *Cormura brevirostris* (Wagner, 1843), *Rhynchonecteris naso* (Weid-Neuweid, 1820), *Lonchorhina aurita* Tomes, 1863, and an undetermined species belonging to the subfamily Glossophaginae (family Phyllostomidae).

Identification. We identified the bats at the rocky outcrop at Fazenda Paloma as *F. horrens* based on direct visual observations of the individuals on the roost by one of the authors (FAGA). The morphological characteristics of these individuals are typical of *F. horrens*, as described by Lima (1926), Uieda et al. (1980), Simmons and Voss (1998), Novaes et al. (2012), Leal et al. (2014), López-Baucells et al. (2016), and Reis et al. (2017). The diagnostic characters of this species includes small body size, dense grey fur with a slightly lighter underbelly, relatively smooth and hairy muzzle, rounded, funnel-shaped ears (Fig. 3B), a tail completely covered by the uropatagium and barely reaching two-thirds of the length of this membrane, and

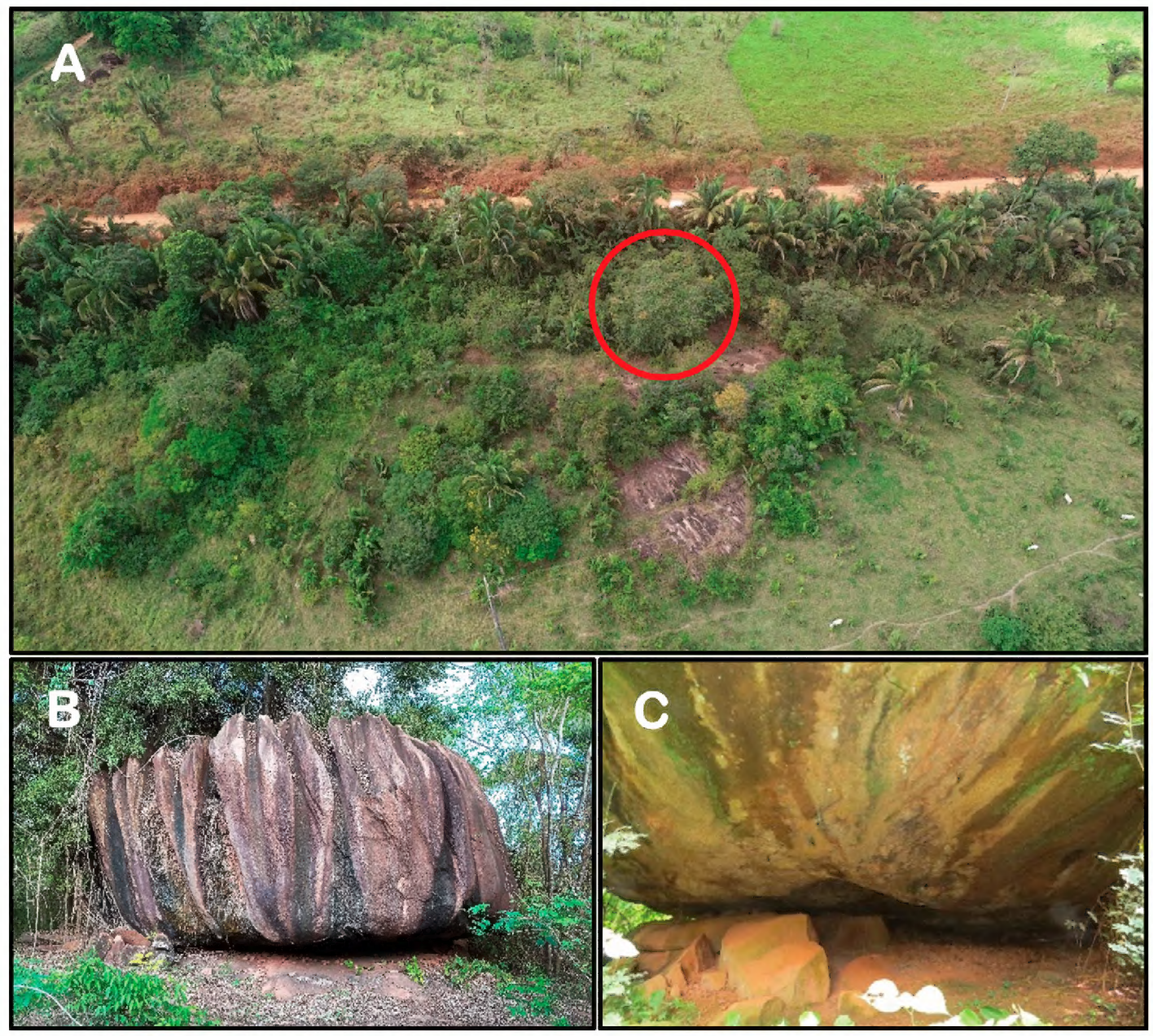

Figure 2. Characteristics of the rocky outcrop at Fazenda Paloma in the municipality of Novo Repartimento, Pará, Brazil, where the new record of *Furipterus horrens* originates. **A.** Aerial photograph showing location of the shelter marked with a red circle. **B.** Rocky outcrop used as shelter by *F. horrens*. **C.** Access to the interior of the shelter.

Figure 3. *Furipterus horrens* roosting under a rocky outcrop at Fazenda Paloma, Pará, Brazil. **A, B.** Perched. **C.** An individual in flight showing that the tail is completely covered by the uropatagium. Photographs: A, C by R.S. Lima 2021; B by L.S. Simões 2021.

very reduced thumbs, which are covered by wing membranes and have vestigial nails (Fig. 3C).

DISCUSSION

Our new record of *F. horrens* adds one more locality of this species in the Amazon Biome, bringing to 10 the number of localities in this biome in Brazil. The updated distribution map of *F. horrens* in Brazil includes 76 localities (Figure 4, Table 1) (Duda et al. 2012; Novaes et al. 2012; Leal et al. 2014; Portella et al. 2017; Vargas-Mena et al. 2018; Vargas-Mena et al. 2020). The nearest previously known occurrence of *F. horrens* to the new locality at Fazenda Paloma is in the Municipality of Anapú, on the Xingú River (Ferreira et al. 2008), 212 km northwest. The next nearest locality is in the Carajás National Forest, 221 km to the southwest in the Municipality of Parauapebas (Tavares et al. 2012).

Most of the landscapes in which *F. horrens* has been recorded until now have been karstic areas with grottos and caves (Uieda et al. 1980; Simmons and Voss 1998; Guimarães et al. 2014; Bredt et al. 2018). A total of 21,499 caves have been catalogued in Brazil, of which almost half (9,997) are found in the Cerrado biome, only 14% (2,999) are found in the Amazon biome, (4,416) in the Atlantic Forest and (3,935) in the Caatinga biome (ICMBio 2021). The remaining caves (<1% of the total) are in coastal areas (109 caves) and the Pampas (37) and Pantanal biomes (12). Despite having the most caves, the Cerrado biome has the fewest records of *F. horrens*. In the Cerrado, *F. horrens* is scarce, and this species has been confirmed in only 0.1% of the caves there. Similarly low occupancy rates are known in the Atlantic Forest (0.5%) and Caatinga (0.6%) biomes. In contrast, the Caatinga biome has many more records (31), although this biome has fewer than half the number of caves as in the Cerrado biome. The high number of records in the Caatinga may be due to the high speleological potential of the biome, which is home to a rich and abundant diversity of cave-dwelling bats, including Vulnerable species such as *F. horrens* (Vargas-Mena et al. 2018).

Our new record of *F. horrens* from Pará does not alter the ranking of Amazonia as the biome with the fourth largest number of localities in Brazil; *F. horrens* has been recorded in only 0.4% of the caves

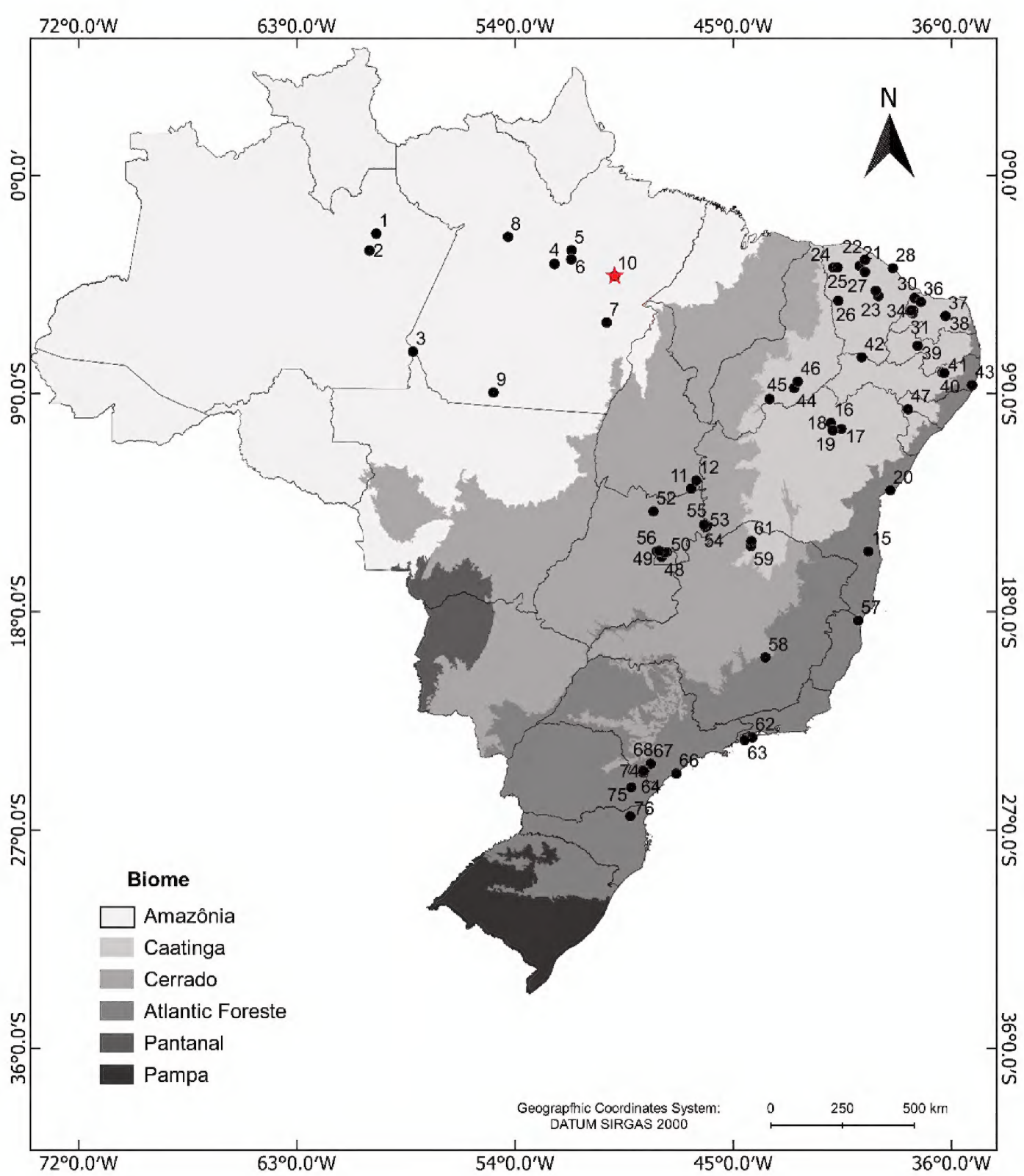

Figure 4. Distribution of *Furipterus horrens* in Brazil. Black dots = previously known occurrences; red star = new record at Fazenda Paloma, Pará, Brazil. The numbers correspond to the locality codes in Table 1.

Table 1. Occurrence localities of *Furipterus horrens* recorded in Brazil. The numbers correspond to the points shown in Figure 4. Brazilian states: AM = Amazonas, BA = Bahia, CE = Ceará, DF = Federal District, ES = Espírito Santo, GO = Goias, MG = Minas Gerais, PA = Pará, PB = Paraíba, PE = Pernambuco, PI = Piauí, PR = Paraná, RJ = Rio de Janeiro, RN = Rio Grande do Norte, SC = Santa Catarina, SE = Sergipe, SP = São Paulo, TO = Tocantins.

No.	Locality	Region	State	Biome	Geographic coordinates	Reference
1	Near road ZF2, outside the BDFFP, Rio Preto da Eva	North	AM	Amazonia	02°24′00″S, 059°43′00″W	Sampaio et al. 2003
2	Manaus	North	AM	Amazonia	03°06′00″S, 060°00′00″W	Piccinini 1974 *
3	Juruena National Park, Maués	North	AM	Amazonia	07°16′00″S, 058°12′00″W	Guimarães 2014 ‡
4	Cachoeira do Espelho, Altamira	North	PA	Amazonia	03°39′00″S, 052°22′00″W	Voss and Emmons 1996
5	"Volta Grande" of the Xingu River, Altamira	North	PA	Amazonia	03°05′00″S, 051°40′00″W	Aguiar et al. 2009
6	Pedral "Barra do Vento", middle-lower Xingu River, Anapú	North	PA	Amazonia	03°27′52″S, 051°40′36″W	Ferreira et al. 2008
7	Carajás National Forest, Parauapebas	North	PA	Amazonia	06°04′00″S, 050°13′00″W	Tavares et al. 2012 *
8	Taperinha, Santarém	North	PA	Amazonia	02°32′00″S, 054°17′00″W	Piccinini 1974 ‡
9	Serra do Cachimbo, Altamira	North	PA	Amazonia	08°57′00″S, 054°53′00″W	Duda et al. 2012 *
10	Fazenda Paloma, Novo Repartimento	North	PA	Amazonia	04°08′56″S, 049°53′17″W	Present study
11	Arraias	North	TO	Cerrado	12°55′00″S, 046°44′00″W	Sato et al. 2011 †‡
12	Aurora do Tocantins	North	TO	Cerrado	12°34′53.4″S, 046°30′59″W	Novaes et al. 2012
13	Gruta Alagada, Dianópolis	North	TO	Cerrado	11°87′47″S, 046°76′89″W	Guimarães 2014
14	PCH Boa Sorte, Dianópolis	North	TO	Cerrado	11°65′42″S, 046°70′87″W	Guimarães 2014
15	Southern Bahia	Northeast	BA	Atlantic Forest	15°30′11″S, 039°25′13″W	Faria et al. 2006 †
16	Toca do Morrinho, Campo Formoso	Northeast	BA	Caatinga	10°12′00″S, 040°58′00″W	Guimarães 2014 ‡
17	Gruta Tiquara, Campo Formoso	Northeast	BA	Caatinga	10°27′09″S, 040°32′11″W	Guimarães 2014
18	Toca Grotão, Campo Formoso	Northeast	BA	Caatinga	10°12′58″S, 040°58′22″W	Guimarães 2014
19	Toca do Gonçalo, Campo Formoso	Northeast	BA	Caatinga	10°30′38″S, 040°53′40″W	Guimarães 2014
20	Salvador	Northeast	BA	Atlantic Forest	12°59′00″S, 038°31′00″W	Gervais 1856 †
21	Irauçuba	Northeast	CE	Caatinga	03°44′00″S, 039°47′00″W	Fabián 2008 *
22	Itapipoca	Northeast	CE	Atlantic Forest	03°29′00″S, 039°34′00″W	Piccinini 1974 † ‡
23	Fazenda Santa Fé, Quixadá	Northeast	CE	Caatinga	04°58′17″S, 039°00′55″W	Astúa and Guerra 2008
24	Gruta Ubajara, Ubajara National Park	Northeast	CE	Caatinga	03°48′00″S, 040°52′00″W	Uieda et al. 1980; Silva et al. 2001
25	Gruta Araticum, Serra Ibiapaba, Vila do Araticum	Northeast	CE	Caatinga	03°48′00″S, 040°42′00″W	Uieda et al. 1980 †
26	Serra das Almas, Crateús	Northeast	CE	Caatinga	05°10′00″S, 040°40′00″W	Silva et al. 2001 *†
27	Furna dos Ossos National Park, Tejuçuoca	Northeast	CE	Caatinga	03°59′00″S, 039°34′00″W	Mammal Coll. at UFP †
28	Serra do Maranguape, Maranguape	Northeast	CE	Caatinga	03°49′38″S, 038°24′48″W	Piccinini 1973 †
29	Serra do Maranguape, Maranguape	Northeast	CE	Caatinga	04°45′10″S, 039°07′05″W	Piccinini 1973 †
30	Furna Feia National Park, Mossoró	Northeast	RN	Caatinga	05°3′24.13″S, 037°30′54″W	Vargas-Mena et al. 2018
31	Caraúbas	Northeast	RN	Caatinga	05°41′10″S, 037°35′38″W	Vargas-Mena et al. 2018
32	Gruta Carrapateira, Felipe Guerra	Northeast	RN	Caatinga	05°33′27″S, 037°40′08W	Vargas-Mena et al. 2020
33	Gruta Casa dos Homens, Felipe Guerra	Northeast	RN	Caatinga	05°34′34″S, 037°34′25″W	Vargas-Mena et al. 2020
34	Gruta Três Lagos, Felipe Guerra	Northeast	RN	Caatinga	05°35′35″S, 037°41′13″W	Vargas-Mena et al. 2020
35	Caverna do Urubu, Felipe Guerra	Northeast	RN	Caatinga	05°34′22″S, 037°39′08″W	Vargas-Mena et al. 2020
36	Casa de Pedra, Martins	Northeast	RN	Caatinga	05°12′44″S, 037°15′50″W	Vargas-Mena et al. 2020
37	Abrigo Xero-xero, Lajes	Northeast	RN	Caatinga	5°47′50.54″S, 036°14′27″W	Vargas-Mena et al. 2020
38	Caverna do Serrote Preto, Lajes	Northeast	RN	Caatinga	05°47′48″S, 036°14′26″W	Vargas-Mena et al. 2020
39	Serra do Tamanduá, Santa Terezinha	Northeast	PB	Caatinga	07°01′31″S, 037°23′31″W	Leal et al. 2014
40	Brejo da Madre de Deus	Northeast	PE	Caatinga	08°08′00″S, 036°22′00″W	Sousa et al. 2004 †
41	Pedra do Caboclo, Brejo da Madre de Deus	Northeast	PE	Caatinga	08°08′45″S, 036°17′48″W	Astúa and Guerra 2008
42	Serrote das Lajes, Exu	Northeast	PE	Caatinga	07°30′00″S, 039°42′00″W	Mares et al. 1981 *†
43	Rio Formoso	Northeast	PE	Atlantic Forest	08°39′00″S, 035°09′00″W	Bonato and Facure 2000
44	Gruta do Inferno, Coronel José Dias	Northeast	PI	Caatinga	08°46′00″S, 042°29′00″W	Guimarães 2014 ‡
45	Serra das Confusões National Park, Guaribas	Northeast	PI	Caatinga	09°13′12″S, 043°29′52″W	Gregorin et al. 2008
46	Serra da Capivara National Park, São Raimundo Nonato	Northeast	PI	Caatinga	08°30′00″S, 042°20′00″W	Araújo et al. 1998 † ‡
47	Fazenda Novo Mundo, Canindé de São Francisco	Northeast	SE	Caatinga	09°38′31″S, 037°47′18″W	Astúa and Guerra 2008
48	Rural zone, Brasília	Midwest	DF	Cerrado	15°44′00″S, 047°57′00″W	Bredt and Uieda 1996 *§
49	Gruta Muralha, Brasilândia	Midwest	DF	Cerrado	15°30′00″S, 048°09′00″W	Bredt et al. 1999
50	Gruta Água Rasa, Planaltina	Midwest	DF	Cerrado	15°32′00″S, 047°44′00″W	Bredt et al. 1999
51	Gruta Mogi, Sobradinho	Midwest	DF	Cerrado	15°33′00″S, 047°49′00″W	Bredt et al. 1999
52	Gruta Bibiana, Cavalcante	Midwest	GO	Cerrado	13°51′13″S, 048°17′12″W	Guimarães 2014
53	Gruta Rib. dos Porcos, Damianópolis	Midwest	GO	Cerrado	14°31′00″S, 046°08′00″W	Guimarães 2014 §
54	Gruta Calcária, Mambaí	Midwest	GO	Cerrado	14°29′00″S, 046°06′00″W	Coimbra et al. 1982 *†
55	APA Nascentes Rio Vermelho, Mambaí	Midwest	GO	Cerrado	14°24′25″S, 046°11′43″W	Esbérard et al. 2005
56	Toca da Gameleira, Padre Bernardo	Midwest	GO	Cerrado	15°29′00″S, 048°03′00″W	Bredt et al. 1999; Bredt and Magalhães 2006
57	Rio Preto National Forest, Conceição da Barra	Southeast	ES	Atlantic Forest	18°21′19″S, 039°50′39″W	Duda et al. 2012
58	Caeté	Southeast	MG	Cerrado	19°52′48″S, 043°40′12″W	Teixeira and Ferreira 2010
59	Gruta Olhos d'Água, Itacarambi	Southeast	MG	Caatinga	15°17′12″S, 044°16′07″W	Guimarães 2014
60	Caverna do Carlucio, Vale do Peruaçú, Itacarambi	Southeast	MG	Caatinga	15°07′69″S, 044°26′03″W	Tavares et al. 2010; Guimarães 2014

Table 1. Continued.

No.	Locality	Region	State	Biome	Geographic coordinates	Reference
61	Gruta Ossos, Cavernas do Peruaçú National Park, Itacarambi	Southeast	MG	Cerrado	15°05′00″S, 044°15′00″W	Tavares et al. 2010
62	Ilha Grande, Angra dos Reis	Southeast	RJ	Atlantic Forest	23°10′33″S, 044°12′28″W	Esbérard et al. 2006
63	Praia da Sumaca, Parati	Southeast	RJ	Atlantic Forest	23°17′12″S, 044°31′44″W	Pol et al. 2003
64	Caverna do Jeremias, PETAR - Santana, Iporanga	Southeast	SP	Atlantic Forest	24°38′15″S, 048°42′02″W	Trajano 1985; Arnone 2008
65	Abismo da Chuva, Iporanga	Southeast	SP	Atlantic Forest	24°16′00″S, 048°25′00″W	Trajano and Gnaspini-Netto 1991
66	Juréia-Itatins Ecological Station, Peruíbe	Southeast	SP	Atlantic Forest	24°40′00″S, 047°21′00″W	Gimenez and Ferrarezi 2004 *†
67	Intervales State Park, Ribeirão Grande	Southeast	SP	Atlantic Forest	24°16′00″S, 048°24′00″W	Portfors et al. 2000; Passos et al. 2003
68	Serra de Paranapiacaba, Capão Bonito	Southeast	SP	Atlantic Forest	24°16′00″S, 048°24′00″W	Fenton et al. 1999
69	Caverna Alambari de Baixo, Iporanga	Southeast	SP	Atlantic Forest	24°33′00″S, 048°40′ 00″W	Trajano 1987
70	Caverna Ouro Grosso, Iporanga	Southeast	SP	Atlantic Forest	24°33′00″S, 048°41′00″W	Trajano 1985
71	Caverna Água Suja, Furnas region, Iporanga	Southeast	SP	Atlantic Forest	24°31′00″S, 048°42′00″W	Trajano 1985
72	Gruta do Grilo, Furnas region, Iporanga	Southeast	SP	Atlantic Forest	24°32′00″S, 048°43′00″W	Trajano 1985
73	Gruta Águas Quentes, Iporanga	Southeast	SP	Atlantic Forest	24°34′00″S, 048°40′00″W	Trajano 1985
74	Abandoned mine I, Jaguatirica, Iporanga	Southeast	SP	Atlantic Forest	24°34′00″S, 048°42′00″W	Trajano 1985
75	Gruta do Bacaetava, Colombo	South	PR	Atlantic Forest	25°13′55″S, 049°12′27″W	Portella et al. 2017
76	Colônia Hansa = Corupá	South	SC	Atlantic Forest	26°25′31″S, 049°14′35″W	Lima 1926; Cherem et al. 2004

* Coordinates from Duda et al. (2012).
† Coordinates from Leal et al. (2014).
‡ Coordinates from Portella et al. (2017).
§ Coordinates from Novaes et al. (2012).

catalogued in this biome (ICMBio 2021). Half of these records are from Pará. Overall, while an enormous number of caves are potentially available to *F. horrens* in Brazil, no data are available on the presence or absence of the species in most caves. This reinforces the need for the protection of cave environments in Brazil.

The available occurrence data on *F. horrens*—and most other bat species in Brazilian caves—are dwarfed by the number of caves in Brazil. Given that this bat is found roosting mainly in caves (Uieda et al. 1980; Simmons and Voss 1998; Guimarães et al. 2014), it is highly likely that it is a cave-dwelling species. Even so, it is premature to conclude that the presence of caves is a primary determinant of the distribution of *F. horrens*, despite Guimarães et al.'s (2014) classification of this species as largely cave-dwelling. It is quite likely that this scenario reflects the scarcity of studies mainly on habitat use, dispersal and population data of the species. Research using different sampling methods such as active search in caves during the day, complemented with the use of mist nets, harp traps and bioacoustics techniques, is needed to produce a more accurate distribution map, which can be used in conservation efforts for *F. horrens*.

With as many as 132 individuals in the Fazenda Paloma colony of *F. horrens*, this location has the second largest agglomeration of bats of this species yet recorded in Brazil, after those observed by Uieda et al. (1980), who recorded 150 individuals in a grotto and 250 in a cave in north-eastern Brazil. Groups of between 30 and 130 individuals have been recorded in other studies (Bredt et al. 1999; Ferreira et al. 2008; Vargas-Mena et al. 2018), although most groups have between one and six bats (Mares et al. 1981; Trajano 1985; Portfors et al. 2000; Silva et al. 2001; Passos et al. 2003; Pol et al. 2003; Sampaio et al. 2003; Esbérard et al. 2006; Gardner 2008; Duda et al. 2012; Novaes et al. 2012; Leal et al. 2014; Portella et al. 2017).

The occupation of the Fazenda Paloma roost by *F. horrens* is unusual in the size of the group and the distribution of individuals within the group. Individuals were in isolation, in pairs, in small groups of 3–10 bats, and in large agglomerations of over 30 individuals. Uieda et al. (1980) noted a complete lack of any well-defined "grouping pattern" in *F. horrens*, and the behaviour observed by us at Fazenda Paloma is consistent with Uieda et al.'s observation.

The Fazenda Paloma colony is located within an anthropogenic environment, an extensive area of cattle grazing on a plain with some rocky outcrops. The colony is only 20 m from the BR 422 federal highway. The presence of *F. horrens* in degraded habitats contrasts considerably with previous studies (La Val 1977; Uieda et al. 1980; Simmons and Voss 1998; Guimarães and Ferreira 2014; Bredt et al. 2018) in which this species has never been recorded in such environments. Like other species that depend on cave refuges, such as *Natalus macrourus* Gervais, 1856 and *Lonchophylla dekeyseri* Taddei et al., 1983 (Guimarães and Ferreira 2014), *F. horrens* is considered sensitive to environmental impacts and unable to adapt to areas affected by human activities (Bredt et al. 2018). It is possible that anthropogenic disturbance has led many wild species

to move to impacted environments and even to suburban and urban areas.

While *F. horrens* appears to be generally associated with humid forests (Handley 1976; Uieda et al. 1980), the Fazenda Paloma roost is located within a vast pasture surrounded by scrubby vegetation and in the vicinity of a major highway. However, none of these features appears to have affected the local abundance of these bats, since based on direct visual observations by one of us (FAGA), the colony has occupied the roost continuously for more than seven years.

The lack of primary forest, the constant noise from the highway, which can reach 87 dB (Liu et al. 2021), and the ease with which predators and other animals may access the roost, could disturb the bats' permanence in this roost at Fazenda Paloma. Nevertheless, nearby watering ponds may compensate, at least in part, for the negative aspects of this landscape. Other studies on insectivorous bats have shown that the proximity of roosts to water, in particular during times of drought, tends to favour the presence of lactating females (Adams et al. 2008) and reduces the potential for water stress (Frick et al. 2012) and dehydration caused by evapotranspiration (Geluso et al. 2012).

Spatial assessment of the area's vegetation composition is still needed, given that Fazenda Paloma is located adjacent to a State Conservation Unit, the Tucuruí Lake Área de Proteção Ambiental (APA do Lago de Tucuruí) (Pará 2002). The municipality of Novo Repartimento holds the largest proportion of the conservation unit's area (39.18%) (https://uc.socioambiental.org/pt-br/arp/2946), which largely consists of land since flooded by Tucuruí Hydroelectric Power Plant on the Tocantins River.

In summary, considering that *F. horrens* is mainly found in caves, our result corroborates previous studies (Uieda et al. 1980; Simmons and Voss 1998; Guimarães et al. 2014; Bredt et al. 2018; Vargas-Mena et al. 2018) and suggest that it is highly likely to be a rare species that depends on rocky habitats with specific requirements for the formation of colonies. Given this, *F. horrens* demands special attention to development effective conservation measures and legal protection of its habitats. This requires additional study of the species in all Brazilian biomes where it occurs. As the association of *F. horrens* with caves is well established and this species is listed as Vulnerable in Brazil (Brazil 2022), the roost on the rocky outcrop at Fazenda Paloma should be given further importance and study. This type of environment may be essential for the preservation of this and other threatened bat species.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author Contributions

Project administration: JCSM. Supervision: ACMO, FAGA. Formal analysis: JCSM. Methodology: JCSM. Investigation: JCSM, LSS, AGTC, RSL, SMCR, CACS. Visualization: JCSM, LSS. Writing – original draft: JCSM, FAGA. Writing – review and editing: GG, MN, MBO, MS, RF.

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Data availability

All data that support the findings of this study are available in the main text.

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